9th Conference on Limestone Hydrogeology in Besançon
9ième Colloque d'Hydrogéologie en Pays Calcaire à Besançon

Session 4
Metrology and data transmission
"Artificial neural network for karst aquifer sustainable management"

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The Syndicat des Eaux du Vivier « SEV » in a few figures

- 5 municipalities including the city of Niort
- about 100.000 people depending on the Vivier karstic spring
- 650 km water networks, 36000 compteurs, 5 main water resources
- 60 agents, in public management
- Hospitals, industry with SEVESO sites, schools…)

What are the mains problems?

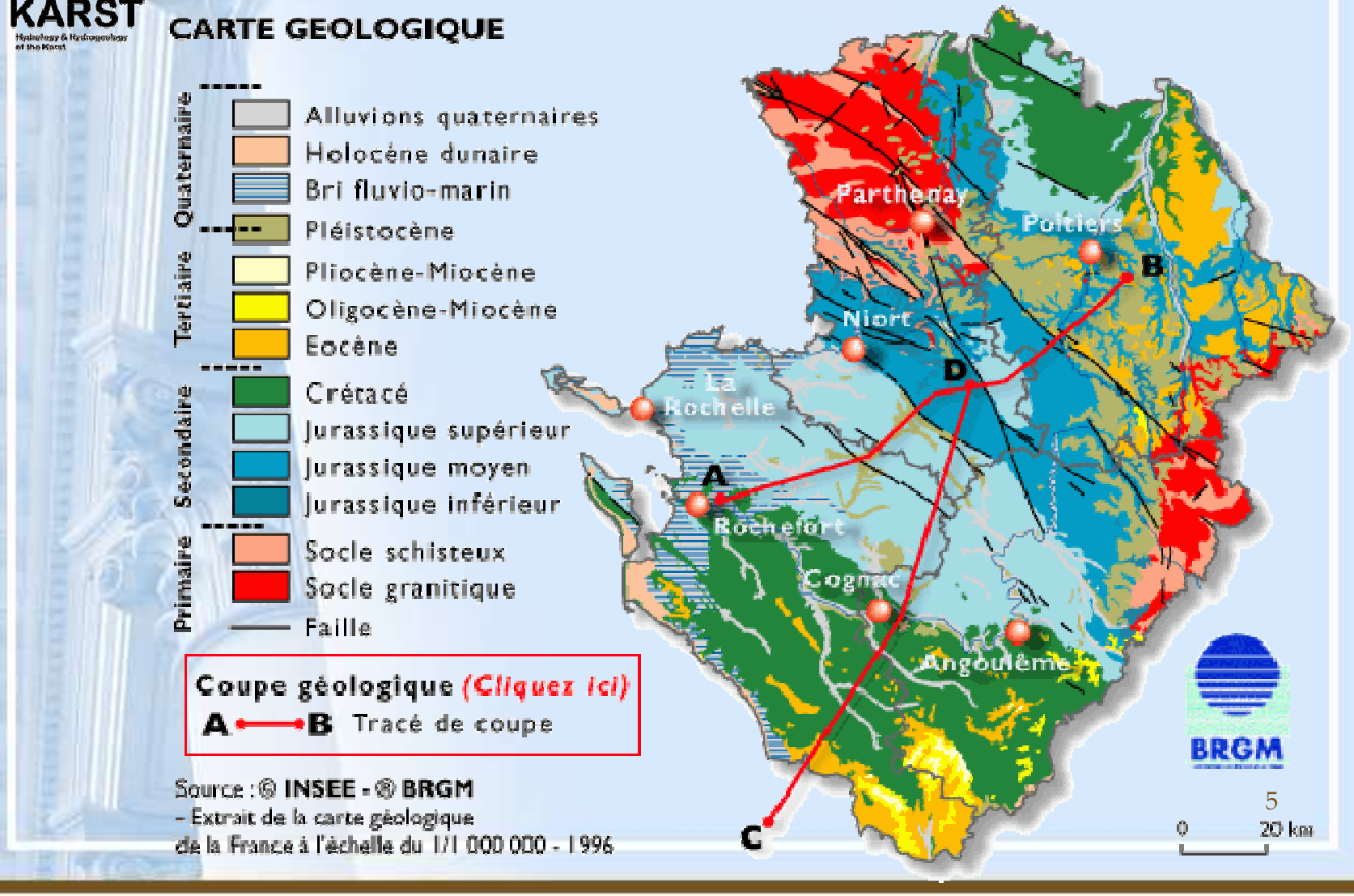
- Agricultural area with intensive production
- Competition with water supply
- Limited and fragile underground resources, with 2 observed karstic collapses in Vivier spring
- Quality problems due to nitrates and pesticides

Our main purposes about quantity

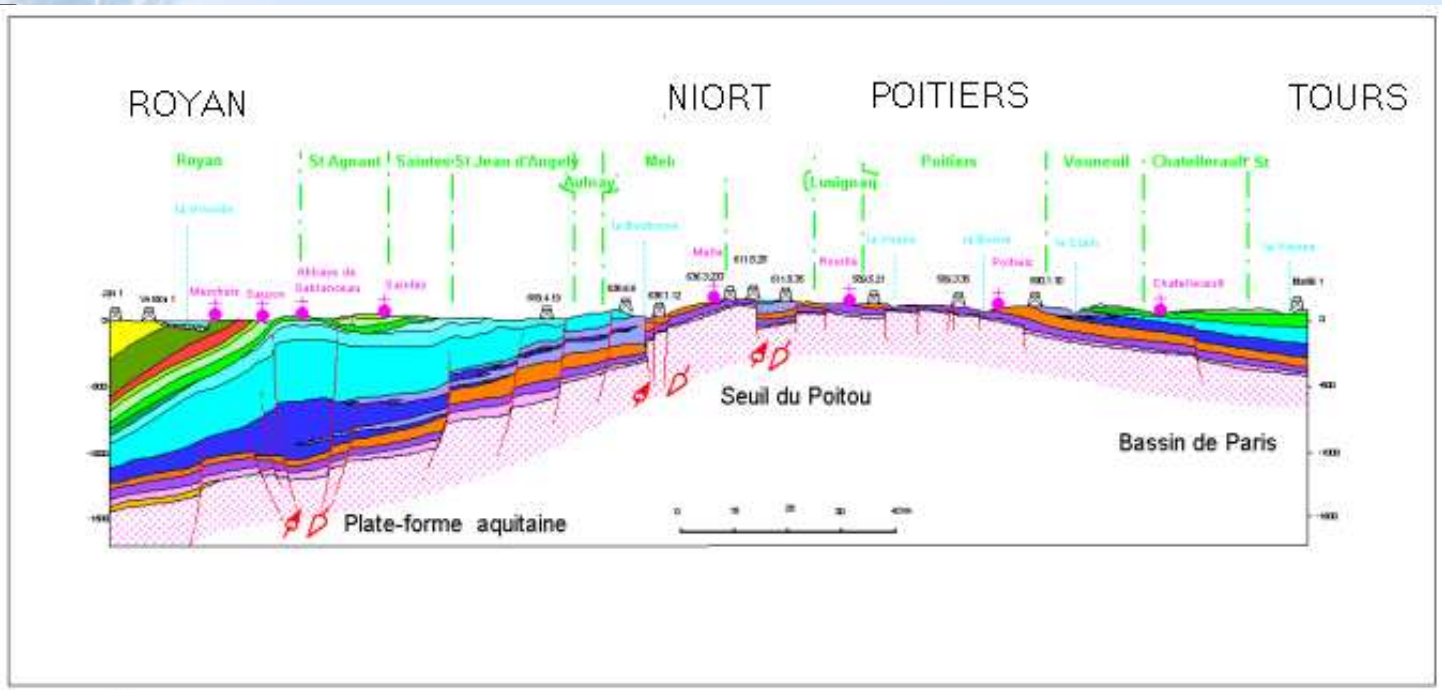
- Securize water supply on our area
- Understand and anticipate needs (peaks, periodicity)
- Understand and modelize water resources (rain effect, cycles, pumping effects…)
- Criterion:

« water resources always > peak needs »

Geological context

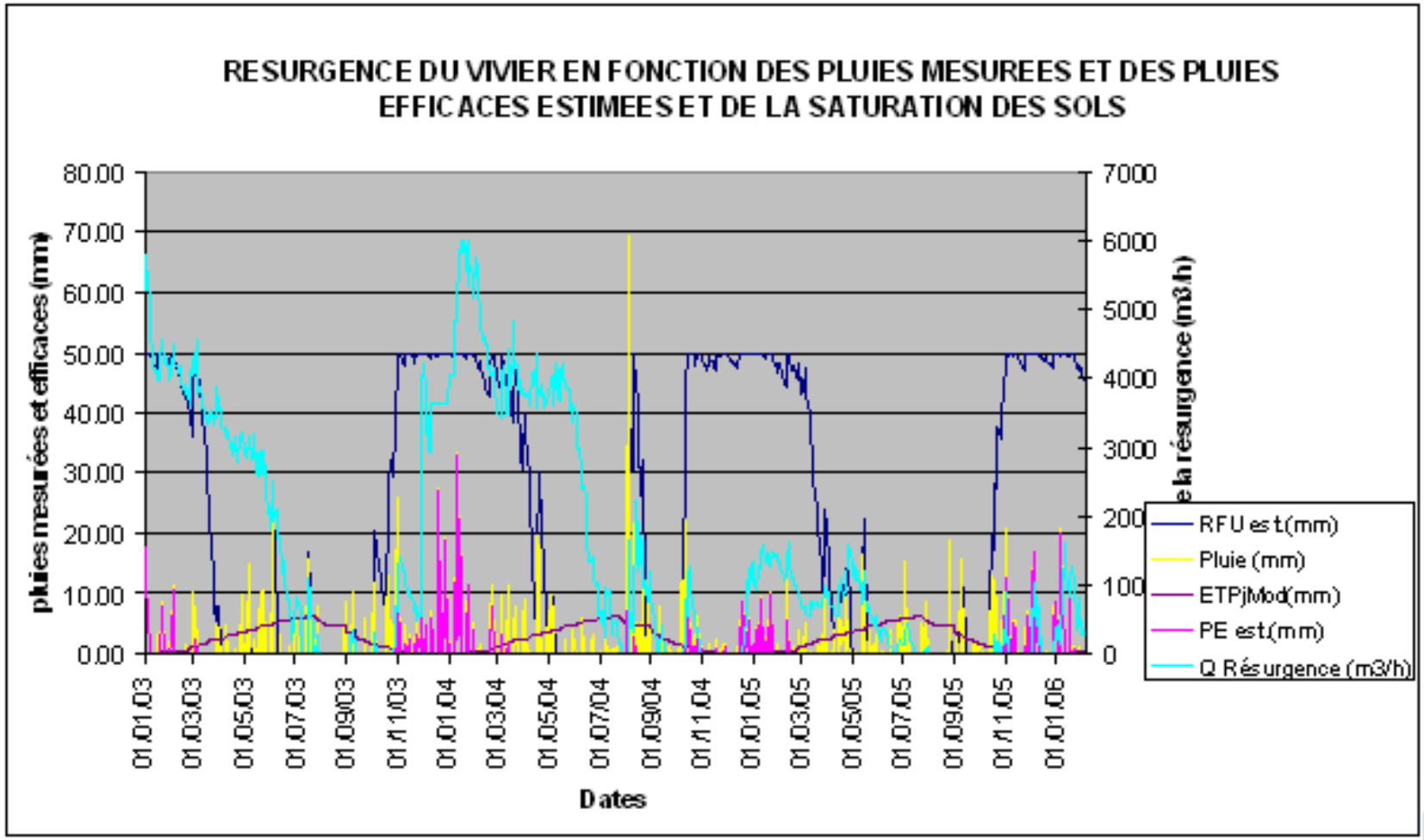


Geological context (AB cut)

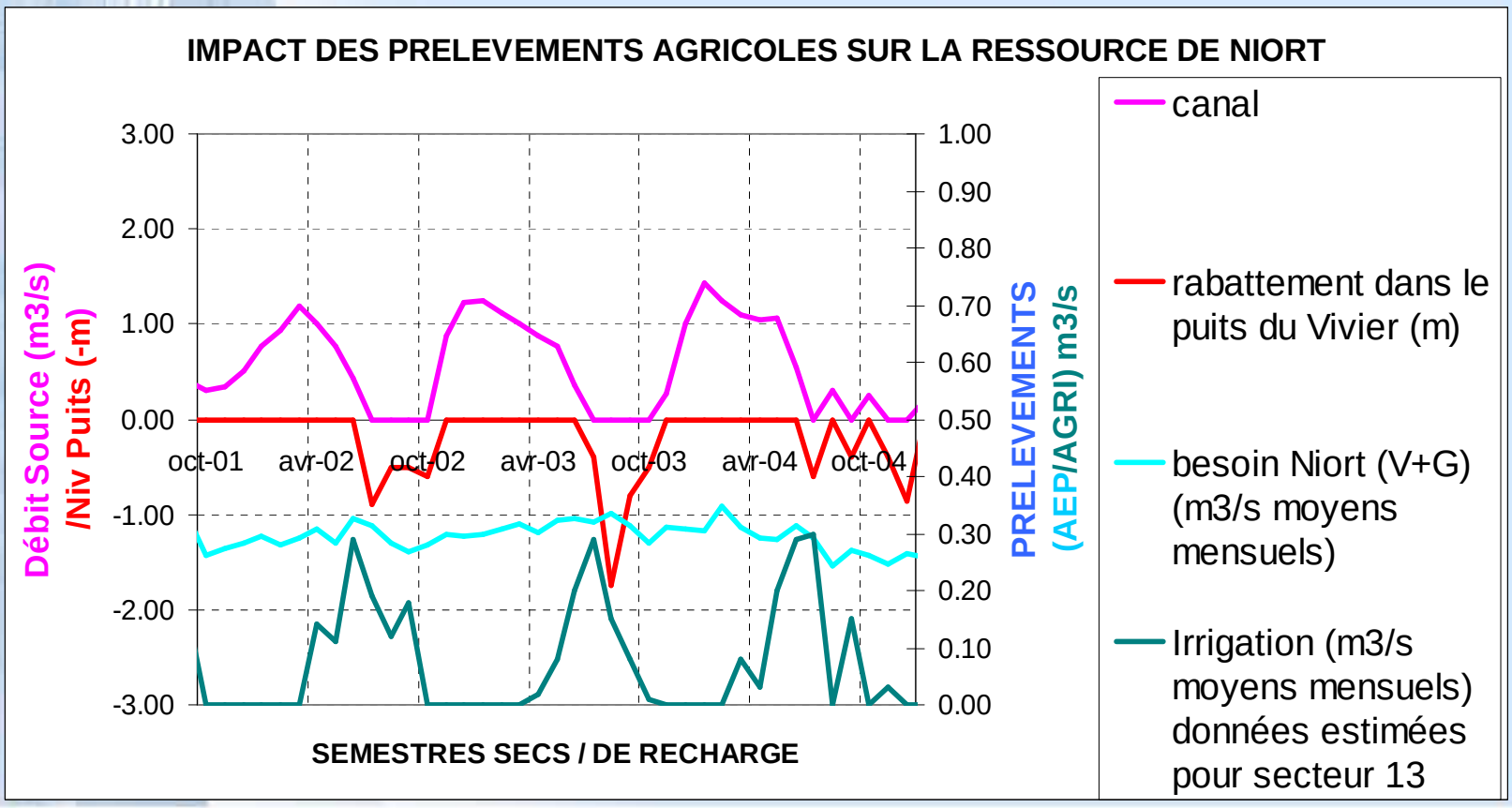


Coupe schématique SW - NE de la Région Poitou-Charentes

Vivier karst observed behaviour



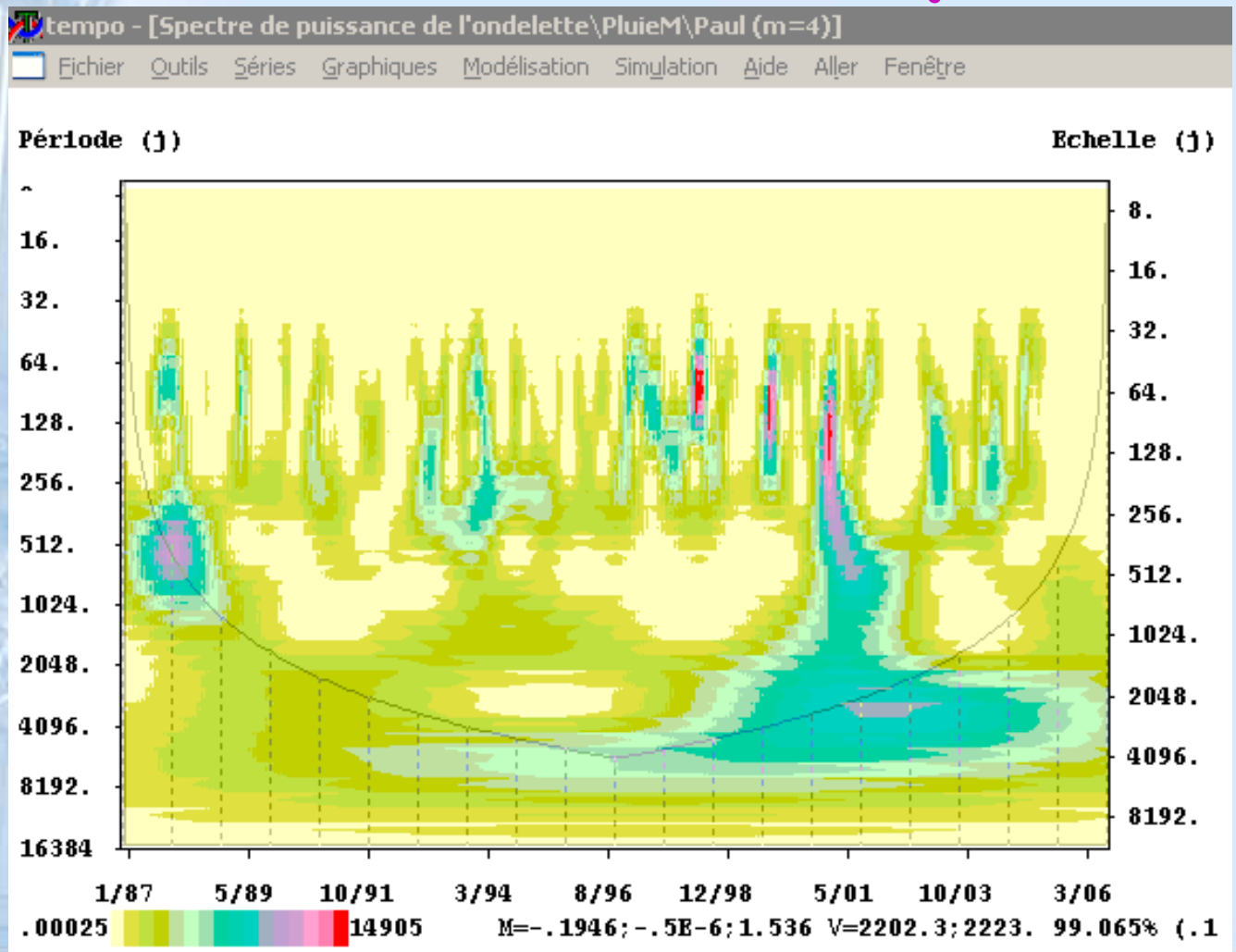
Effects of pumpings for irrigation and water supply



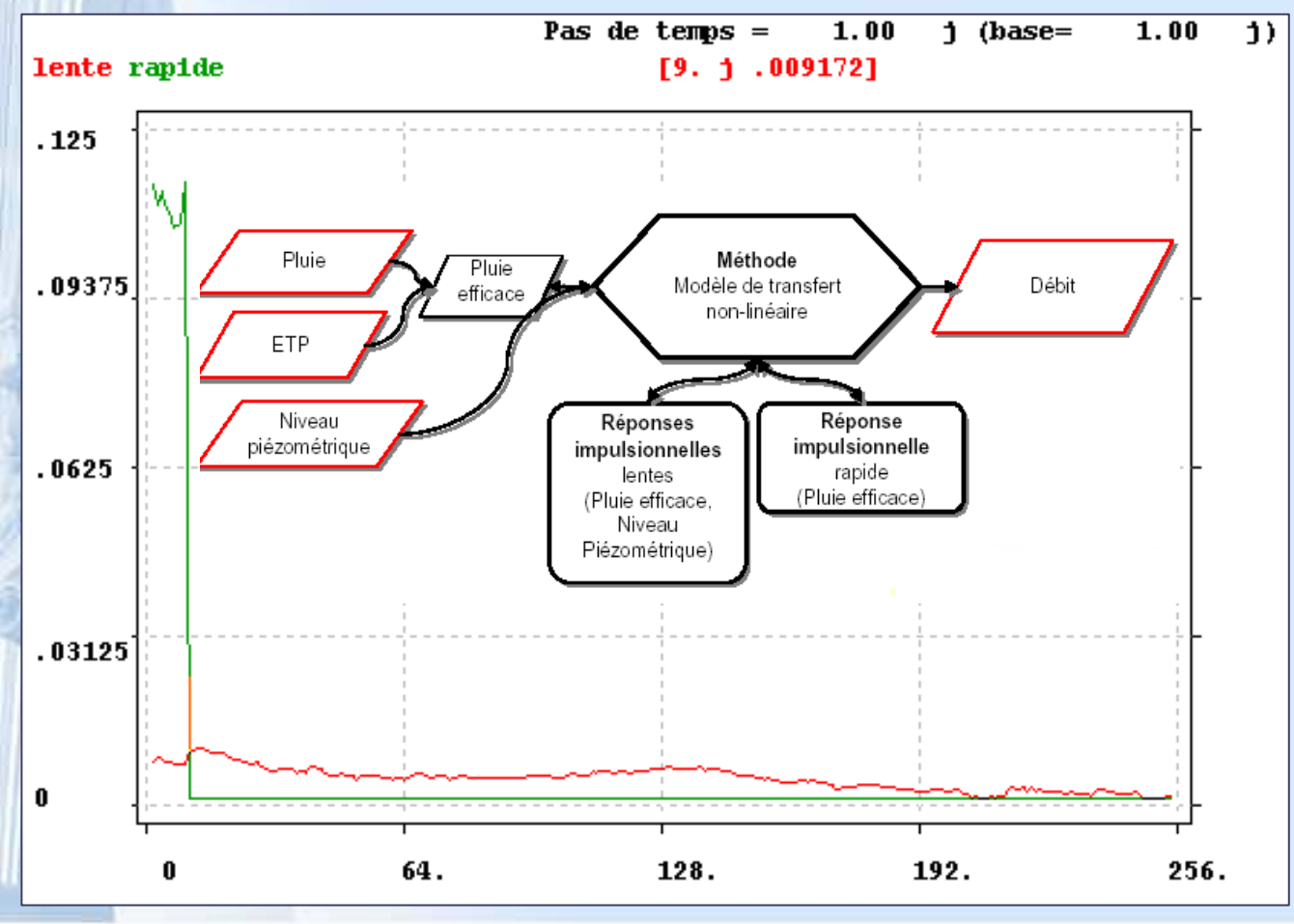
Methodology followed

- 1 : Data collecting, selecting…and mining (ACP, geostatistics, wavelets…)
- 2 : Modelling with different techniques (lumped modelling of rainfall – runoff and rainfall aquifer level, inverse modelling using fourier analysis, neural networks…)
- 3: Forecasting with rainfall simulation
- 4: Managing resources…ie how to keep « water resources always > peak needs »

Rainfall data analysis



Inverse modelling (TEMPO BRGM)



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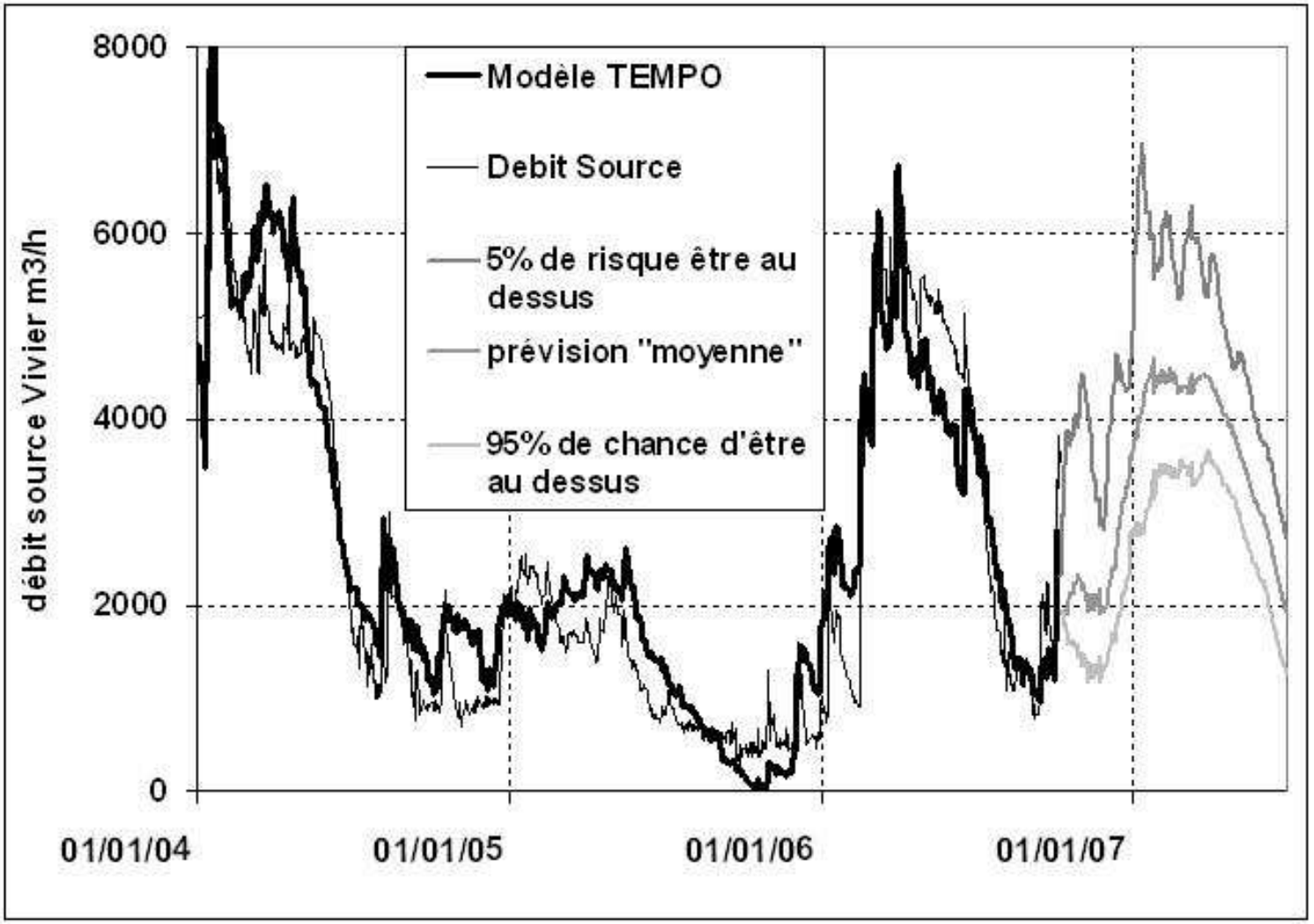
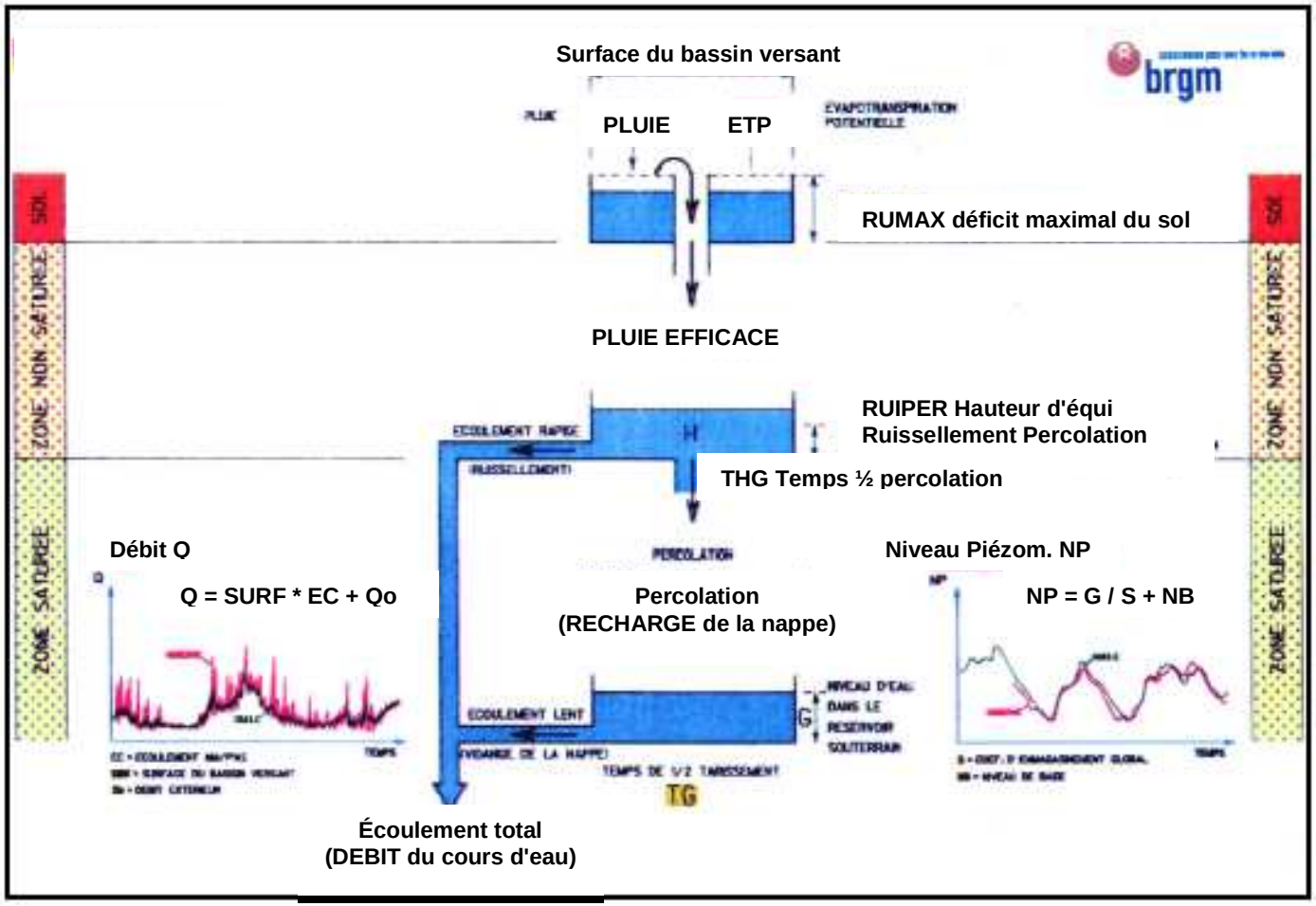
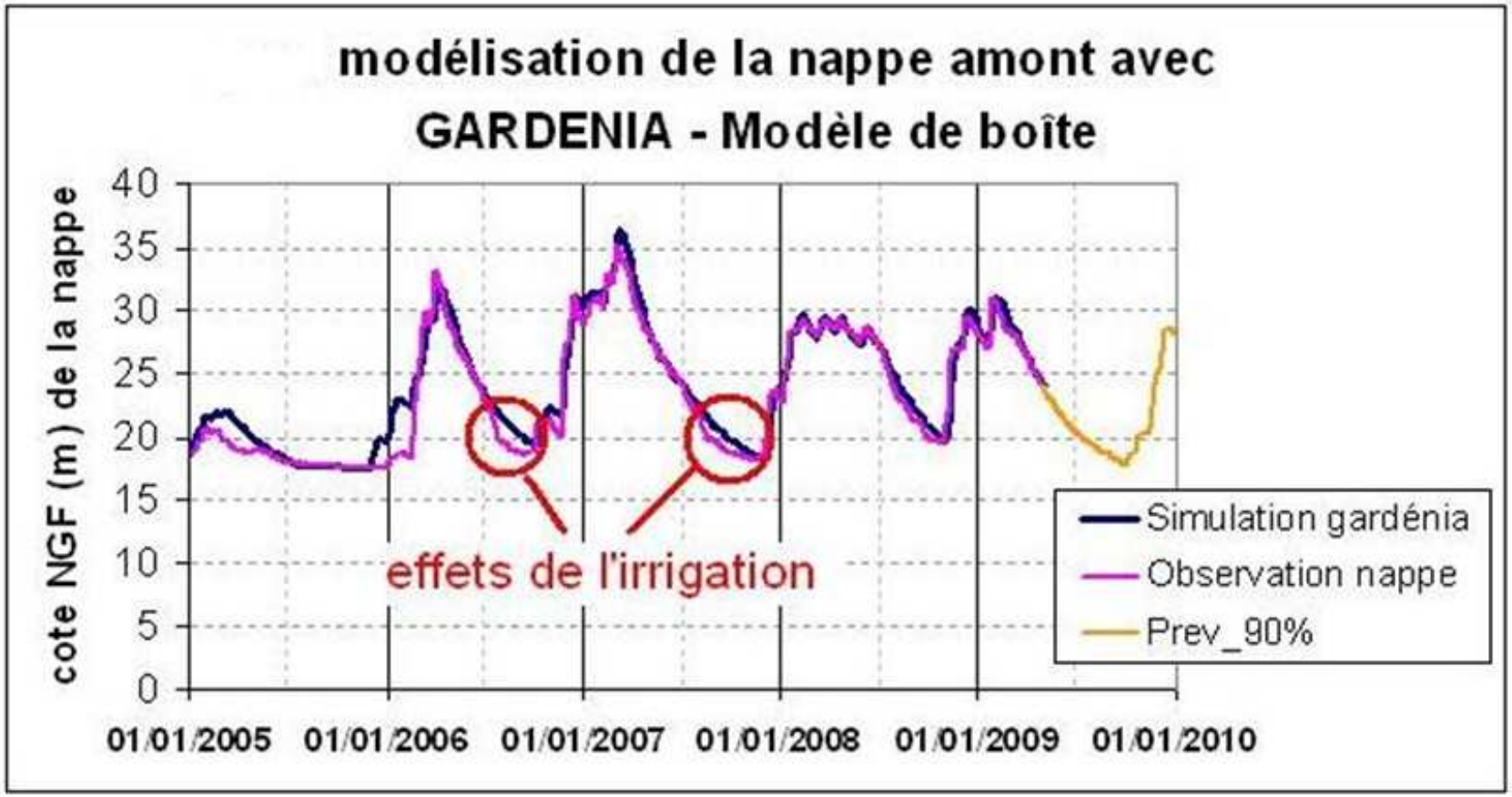


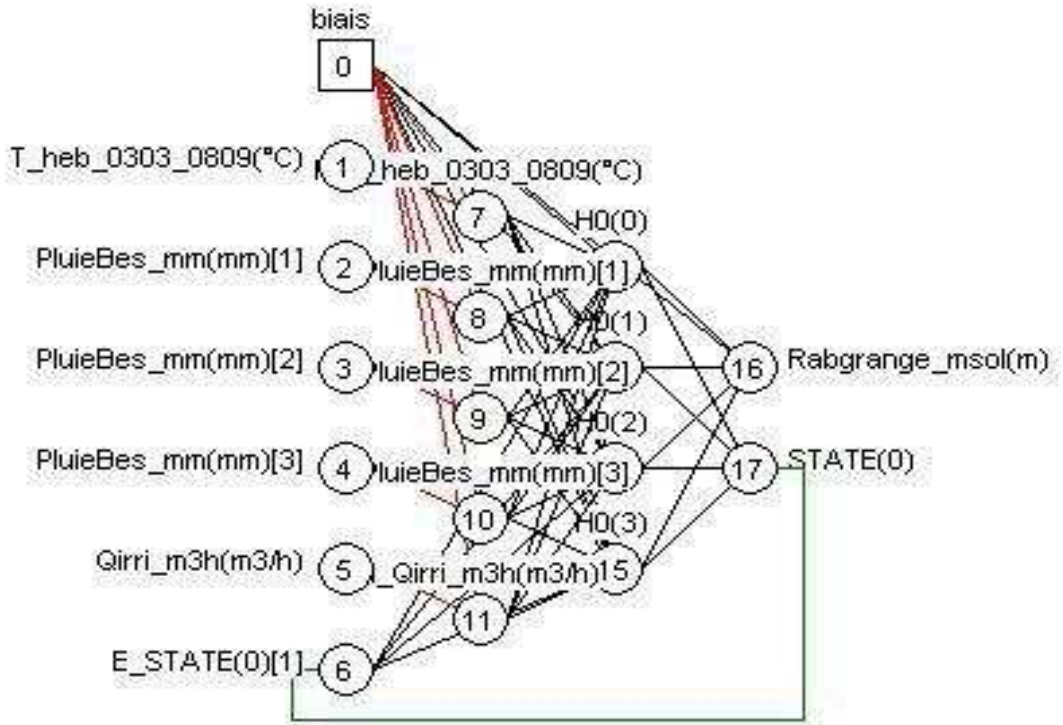
Hydrological modelling (GARDENIA BRGM)



Hydrological modelling (GARDENIA BRGM)

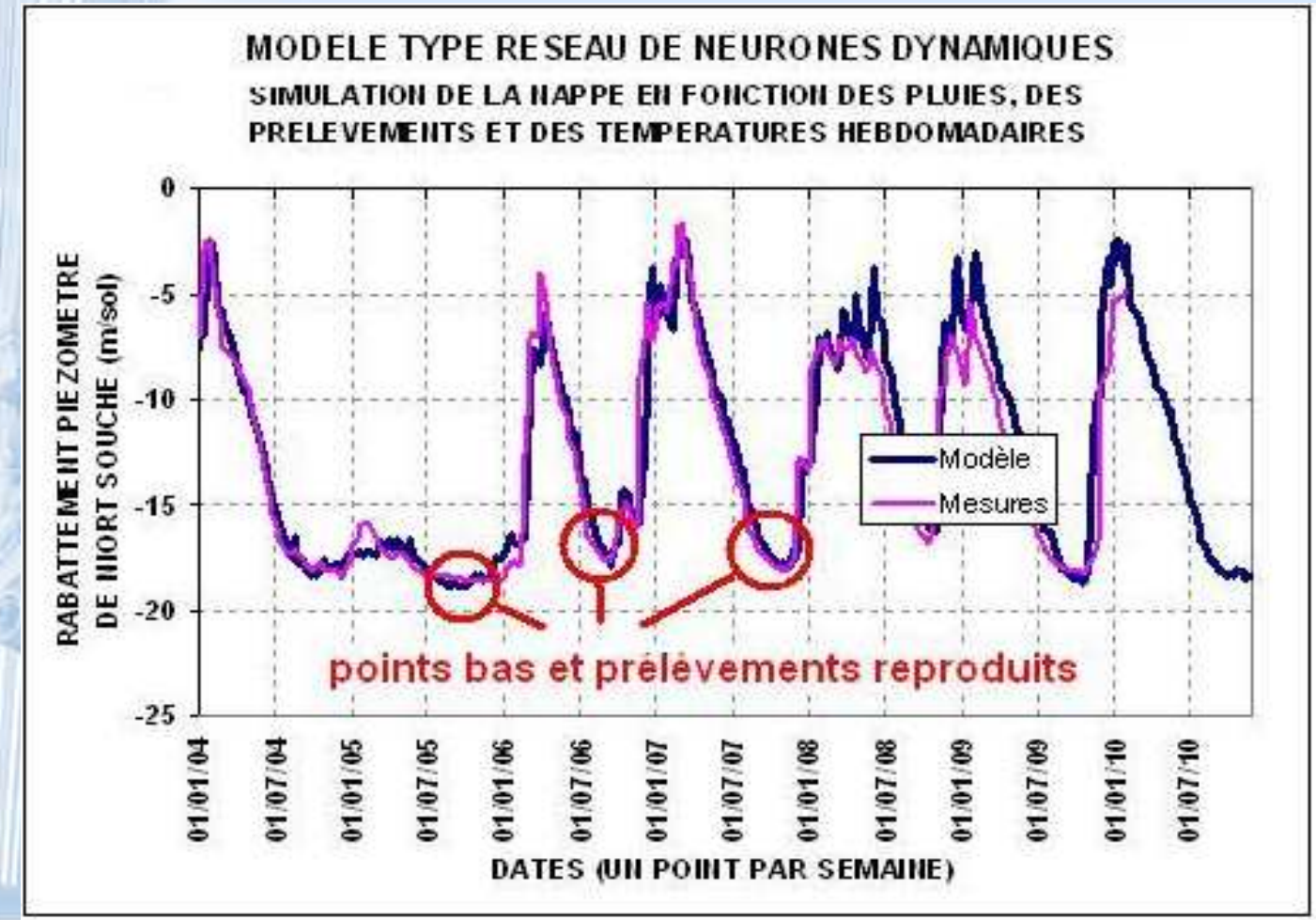


Artificial neural network modelling (Neuro one Netral)

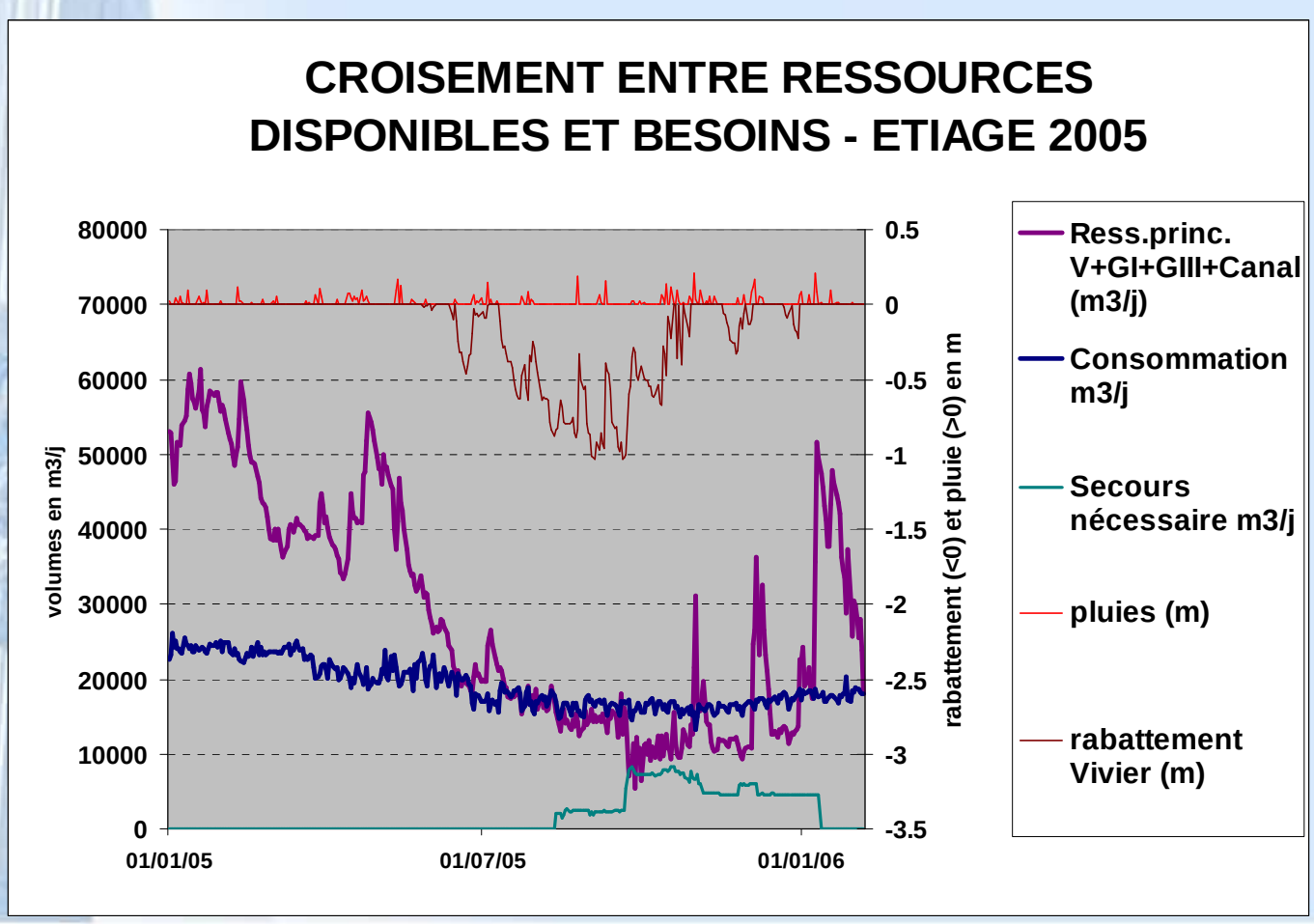


Sortie: Rabqrange = piézo hebdo moyenne modélisée
Entrées: T_heb_...: température moyenne hebdomadaire
PluiBes...: pluies des semaines 1,2 et 3 d'avant
Qirri...: prélèvements agricoles hebdomadaires estimés
biais, E_STATE... : paramètres internes liés au calcul neuronal effectué

Artificial neural network modelling



Example of use of this model: Crisis anticipation and management



Conclusion: advantages of ANN tools

- After choosing a good model, easy qnalytical formulation under Excel…
- « Intelligent » black box, but to use under constraints (learning sets must include extrem years)
- Easy to use for simulations (pumpings for irrigation or water supply, climate…)
- Easy to use for sensitivity analysis